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10/511,212	10/13/2004	Steven T Peake	GB 020048	2126

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EXAMINER

LEE, EUGENE

ART UNIT	PAPER NUMBER
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2815

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/17/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

DETAILED ACTION

Drawings

1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the distance between two immediately adjacent ruggedness regions is greater than a distance between two immediately adjacent source regions (claim 15) must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

The term “immediately” appears to signify the region that is closest to that region as opposed to a same region that is farther apart.

From the drawings (see, for example, FIG. 1), the distance between two ruggedness regions 15 appears equal to a distance between source regions 13. In FIG. 2, the immediately adjacent source regions (found horizontally to each other as opposed to vertically) also appear to have a same distance as the ruggedness regions 15 which are also found horizontally from each other.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as “amended.” If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the

renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claim 15 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The specification does not describe a distance between two immediately adjacent ruggedness regions is greater than a distance between two immediately adjacent source regions. "Immediately" is construed as being the **closest** region. Appropriate clarification and/or correction are required.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1 thru 9, and 11 thru 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Darwish et al. 5,688,725 in view of Kocon et al. 6,351,009 B1. Darwish discloses (see, for example, FIG. 11G) a vertical trench MOSFET (vertical power transistor trench-gate semiconductor device) comprising a semiconductor body, active area, plurality of electrically parallel transistor cells, gates (trench-gates) 102, N+ source regions (source regions) 112, N-drift region (drain regions) 111, P body (channel-accommodating region) 116, and deep P+ region (ruggedness regions) 114. Darwish does not disclose source regions and the ruggedness regions ... as alternating stripe areas having a width perpendicular to and fully between each of two adjacent parallel stripe trench-gates. However, Kocon discloses (see, for example, FIG. 3C, and 4) trench gates 307 alternating in between P+ body regions 304, and N+ source regions 306. In column 5, lines 1-5, Kocon discloses that such an arrangement exploits the advantage of device size reduction. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to have source regions and the ruggedness regions ... as alternating stripe areas having a width perpendicular to and fully between each of two adjacent parallel stripe trench-gates in order to exploit the advantage of device size reduction.

Regarding claim 2, Darwish in view of Kocon does not disclose the cell pitch being less than 2 um, and wherein the length of the source region stripes being in the range 10 um to 50 um. However, it was well within the skills of an artisan in the art to optimize the performance of a semiconductor device by adjusting the cell pitch and length of source region stripes in order to have an array of cells adequately operating in a reduced space. Therefore, it would have been

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obvious to one of ordinary skill in the art at the time of invention was made to have the cell pitch being less than 2 μm , and wherein the length of the source region stripes being in the range 10 μm to 50 μm because it was well within the skills of an artisan to optimize the performance of a semiconductor device by adjusting the cell pitch and length of source region stripes in order to have an array of cells adequately operating in a reduced space. See *In re Aller*, 105 USPQ 233.

Regarding claims 3-9, the limitations contained in claims 3-9 are functions of the cell pitch, and optimized in the same manner as the paragraph above.

Regarding claims 11, and 12, Darwish in view of Kocon does not disclose the doping concentration of the ruggedness regions being approximately 10 times greater than the doping concentration of the source regions, and the doping concentration of the ruggedness regions being about 10^{21} cm^{-3} and the doping concentration of the source regions being about 10^{20} cm^{-3} . However, it was well within the skills of an artisan in the art to optimize the performance of a semiconductor device by adjusting the doping concentrations of the ruggedness regions and the source regions in order to provide a semiconductor region that can adequately conduct a current from the source to the drain in a vertical trench MOSFET. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to have the doping concentration of the ruggedness regions being approximately 10 times greater than the doping concentration of the source regions, and the doping concentration of the ruggedness regions being about 10^{21} cm^{-3} and the doping concentration of the source regions being about 10^{20} cm^{-3} because it was well within the skills of an artisan to optimize the performance of a semiconductor device by adjusting the doping concentrations of the ruggedness regions and the

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source regions in order to form a semiconductor regions that can adequately conduct a current from the source to the drain. See *In re Aller*, 105 USPQ 233.

Regarding claim 13, see, for example, FIG. 11G wherein Darwish discloses the deep P⁺ region extending further into the drift region 111 than the gates 102.

Regarding claim 14, see, for example, column 2, lines 32-36 wherein Darwish discloses the breakdown voltage being likely 60 volts or less (drain-source breakdown voltage of the device is in the range up to about 50 volts).

6. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Darwish et al. '725 in view of Kocon et al. '009 B1 as applied to claims 1-9, and 11-14 above, and further in view of Mo 6,316,806 B1. Darwish in view of Kocon does not disclose the semiconductor body being silicon. However, Mo discloses (see, for example, column 3, lines 40-44) a semiconductor device comprising a silicon wafer 44 wherein a trench is formed therein. It would have been obvious to one of ordinary skill in the art at the time of invention to have the semiconductor body being silicon in order to adequately form semiconductor regions in a semiconductor device such as a MOSFET.

Regarding the limitation "the ruggedness regions have ... doping concentration in the range of 10^{10} cm^{-3} to 10^{22} cm^{-3} , and wherein the source regions have ... a doping concentration in the range of 10^{18} cm^{-3} to 10^{21} cm^{-3} . However, it was well within the skills of an artisan in the art to optimize the performance of a semiconductor device by adjusting the doping concentrations of the ruggedness regions and the source regions in order to provide a semiconductor region that can adequately conduct a current from the source to the drain in a vertical trench MOSFET.

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Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to have the ruggedness regions have ... doping concentration in the range of 10^{10} cm^{-3} to 10^{22} cm^{-3} , and wherein the source regions have ... a doping concentration in the range of 10^{18} cm^{-3} to 10^{21} cm^{-3} because it was well within the skills of an artisan to optimize the performance of a semiconductor device by adjusting the doping concentrations of the ruggedness regions and the source regions in order to form a semiconductor regions that can adequately conduct a current from the source to the drain. See *In re Aller*, 105 USPQ 233.

Response to Arguments

7. Applicant's arguments filed 10/23/06 have been fully considered but they are not persuasive.

Regarding the applicant's argument on page 6 of the response filed 10/23/06 that Kocon does not disclose a ruggedness region, this argument is not persuasive. Darwish discloses (see, for example, FIG. 11G) a ruggedness region 114 that extends from a P-body 116. Even though Darwish does not use the same terminology as the applicant's invention, it is structurally the same as the ruggedness region defined (see, for example, FIG. 1 wherein ruggedness region 15 extends from a p-type region 14) by the applicant's invention. Kocon does not expressly disclose a ruggedness region, however, since Darwish already discloses a ruggedness region, which is an extension of the p body (which is synonymous to the P+ body region 304 of Kocon) 116, applying the Kocon reference to Darwish would not affect Darwish's ruggedness region and the benefits of the alternating arrangement. Also, as shown in FIG. 2B (even though a prior art figure, it represents the general plan structure of Darwish's invention) of Darwish and FIG. 4 of

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Kocon, the overall structures are the same. Regarding the applicant's argument on page 7 that the ensuing Darwish embodiment would no longer have trench gates that are accessible for signal contacts, this argument is not persuasive. Looking at FIG. 4 of Kocon wherein the trench gates 207 are between the body regions 204, it is clear that such an array arrangement would help minimize size, and not affect the signal contacts. It is not clear why the signal contacts would be affected since the contact 118 is the only contact present, and would not be affected by incorporating Kocon.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

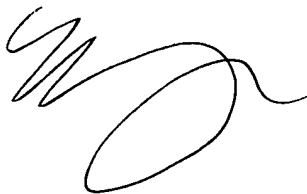
INFORMATION ON HOW TO CONTACT THE USPTO

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eugene Lee whose telephone number is 571-272-1733. The examiner can normally be reached on M-F 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on 571-272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Eugene Lee
January 4, 2007



EUGENE LEE
PRIMARY EXAMINER